

UPPER EXTREMITIES

PP = Part Position

RP = Reference Point

CR = Central Ray

SS = Structure Shown

ER = Examination Rationale

⊥ = Perpendicular

// = Parallel

b/n = between

TRAUMA & FRACTURE TERMINOLOGY

1.) Fracture

- A break in a bone

2.) Simple/Closed Fx

- Does not break through the skin

3.) Compound/Open Fx

- Portion of the bone protrudes through the skin

4.) Incomplete/Partial Fx

- Does not traverse through entire bone
- **Torus/Buckle Fx:** buckle in the cortex with no complete break
- **Greenstick Fx/Willow Stick/Hickory Stick:** fracture is on one side only (commonly in children)

5.) Complete Fx

- Break is complete & bone is broken into two pieces
- **Transverse Fx:** near right angle to long axis of the bone
- **Oblique Fx:** at an oblique angle to the bone
- **Spiral Fx:** bone is twisted apart & spirals around the long axis of bone

6.) Comminuted Fx

- Bone is splintered or crushed (two or more fragments)

7.) Impacted Fx

- One fragment is firmly driven into the other

8.) Avulsion Fx

- A fragment of bone is separated or pulled away

9.) Dislocation/Luxation

- Bone is displaced from a joint

10.) Subluxation

- Partial dislocation

11.) Rolando Fx

- Comminuted fx of 1st MCP base

12.) Bennett's Fx

- Transverse fx of 1st MCP base

13.) Boxer's Fx

- 4th-5th metacarpal neck fx

14.) Colles' Fx/Dinnerfork/Bayonet

- Fx of distal radius w/ posterior/dorsal displacement

15.) Smith Fx/Reverse Colles'

- Fx of distal radius w/ anterior/palmar displacement

16.) Barton's Fx

- Fx of posterior lip of distal radius

17.) Baseball/Mallet Fx

- Fx of distal phalanx

18.) Hutchinson's/Chaffeur's Fx

- Intraarticular fx of the radial styloid process

19.) Monteggia's Fx

- Fx of proximal half of the ulna with radial head dislocation

20.) Nursemaid's/Jerked Elbow

- Partial dislocation of the radial head of a child

A.) DIGITS (2nd-5th)

PA PROJECTION

PP: Palmar surface down; separate the digits slightly

RP: PIP joint

CR: ⊥

SS: PA projection of affected digit

AP Projection: For suspected joint injury

UPPER EXTREMITIES

LATERAL PROJECTION

PP: Hand rest on radial surface (for 2nd-3rd digits) & ulnar surface (for 4th-5th digits)

RP: PIP joint

CR: ⊥

SS: Lateral projection of affected digit

PA OBLIQUE PROJECTION

PP: Hand pronated; lateral rotation (for 4th & 5th); medial rotation (2nd & 3rd)

RP: PIP joint

CR: ⊥

SS: PA oblique projection of affected digit

B.) THUMB (1st Digit)

AP PROJECTION

PP: Hand in extreme internal rotation

RP: 1st MCP joint

CR: ⊥

SS: AP projection of thumb

PA PROJECTION

PP: Hand in lateral position; dorsal surface of thumb // to IR

RP: 1st MCP joint

CR: ⊥

SS: Magnified PA projection of thumb

LATERAL PROJECTION

PP: Hand in its natural arched position; palmar surface down

RP: 1st MCP joint

CR: ⊥

SS: Lateral projection of thumb

PA OBLIQUE PROJECTION

PP: Hand in slight ulnar deviation; thumb abducted

RP: 1st MCP joint

CR: ⊥

SS: PA oblique projection of thumb

C.) FIRST CARPOMETACARPAL (CMC) JOINT

ROBERT METHOD

AP PROJECTION

PP: Shoulder, elbow & wrist on same plane (prevent carpal bones elevation & closing 1st CMC joint); arm internally rotated; hand hyperextended; dorsal aspect of thumb against IR

RP: 1st CMC joint

CR: ⊥; 10-15° proximally (Lewis Method); 15° proximally (Rafert-Long Method)

SS: 1st CMC joint

ER: To demonstrate arthritic changes; fractures; 1st CMC joint displacement; Bennett's fracture

Angulation Rationale: To project soft tissue of the hand away from 1st CMC joint; help open joint space

BURMAN METHOD

AP PROJECTION

PP: Hand hyperextended; opposite hand hold the hyperextended hand or bandage loop around digits; hand rotated internally; thumb abducted

RP: 1st CMC joint

CR: 45° toward the elbow

SS: Magnified 1st CMC joint

ER: To provide a clearer image of 1st CMC than standard AP

FOLIO METHOD/SKIER'S THUMB

PA PROJECTION

PP: Hands rested on medial aspect; distal portion of both thumbs wrap around by a rubber band; thumb in PA plane

RP: b/n level of MCP joints of both hands

CR: ⊥

SS: 1st CMC joint; bilateral MCP joints & MCP angles

ER: Useful for diagnosis of ulnar collateral ligament (UCL) rupture\

UPPER EXTREMITIES

D.) HAND

PA PROJECTION

PP: Hand palmar surface down; spread finger slightly

RP: 3rd MCP joint

CR: \perp

SS: PA oblique projection of the hand

AP Projection:

- Hand cannot be extended because of injury and pathologic conditions
- For metacarpal bones and MCP joints

PA OBLIQUE PROJECTION

PP: Hand pronated; palmar surface down; MCP joints 45° to IR; 45° foam wedge

RP: 3rd MCP joint

CR: \perp

SS: PA oblique projection of the hand

ER: To investigate fractures and pathologic conditions

Foam Wedge: For interphalangeal joints

Fingertips Touching The Cassette: For metacarpal bones

Index Finger Elevation:

- Use of radiolucent material
- Opens joint spaces
- Reduces the degree of foreshortening of phalanges

REVERSE OBLIQUE PROJECTION

Lane-Kennedy-Kuschnier Recommendations

PP: Hand rotated 45° internally

RP: 3rd MCP joint

CR: \perp

ER: To demonstrate severe metacarpal deformities fractures

TANGENTIAL OBLIQUE PROJECTION

Kallen Recommendation

PP: Hand in PA position; hand rotated 40-45° toward ulnar surface & 40-45° forward; MCP joints flexed 75-80°; hand dorsum resting on IR

RP: MCP joint of interest

CR: \perp

ER: To demonstrate metacarpal head fractures

LATERAL PROJECTION

In Extension

PP: Hand in lateral position; digits extended; ulnar aspect down (lateromedial projection); radial aspect down (mediolateral projection; more difficult to assume); thumb 90° to palm

RP: 2nd MCP joint

CR: \perp

SS: Lateral projection of the hand in extension

ER: To localize foreign bodies and metacarpal fracture displacement

Fan Lateral Position: Eliminates superimposition of all phalanges (except proximal phalanges)

LEWIS METHOD

PP: Hand rotated 5° posteriorly from true lateral position (removes superimposition of 2nd-4th metacarpals); thumb extended;

RP: Midshaft of 5th metacarpal

CR: \perp

ER: To better demonstrate fractures of 5th metacarpal

LATERAL PROJECTION

In Flexion

PP: Hand in natural arch position; digits relaxed

RP: 2nd MCP joint

CR: \perp

SS: Lateral projection of the hand in flexion

ER: To demonstrate anterior or posterior displacement in fractures of metacarpals

UPPER EXTREMITIES

NORGAARD METHOD

AP OBLIQUE PROJECTION

PP: Hand supinated; medial aspect against IR; 45°
sponge support

RP: b/n level of 5th MCP joints of both hands

CR: ⊥

SS: AP oblique projection of both hands

ER: To diagnose rheumatoid arthritis

E.) WRIST

PA PROJECTION

PP: Hand slightly arch (places wrist in close contact with IR)

RP: Midcarpal area

CR: ⊥

SS: Slightly oblique rotation of ulna (AP should be taken if ulna is under examination)

Daffner-Emmerling-Buterbaugh

Recommendation

PP: Hand slightly arch (places wrist in close contact with IR)

RP: Midcarpal area

CR: 30° toward the elbow; 30° toward the fingertips

SS: Elongated scaphoid & capitate (toward the elbow); elongated capitate only (toward the fingertips)

ER: To better demonstrate the scaphoid & capitate

AP PROJECTION

PP: Hand supinated; digits elevated (places wrist in close contact with IR)

RP: Midcarpal area

CR: ⊥

SS: Carpal interspaces better demonstrated; no rotation of ulna

LATERAL PROJECTION

Lateromedial

PP: Elbow flexed 90°; hand & forearm in lateral position; ulnar surface against IR; radial surface against IR (for comparison)

RP: Midcarpal area

CR: ⊥

SS: Proximal metacarpals & distal radius & ulna; trapezium & scaphoid (more anterior)

ER: To demonstrate anterior or posterior displacement in fractures

Burman & et al. Suggestions

PP: Wrist in palmar flexion (rotates the scaphoid in dorsovolar position)

RP: Scaphoid

CR: ⊥

SS: Lateral position of the scaphoid

Foille

- First to describe *carpe bossu* (carpal boss), a small bony growth occurring on the dorsal surface of the 3rd CMC joint
- Best demonstrated in a lateral position of wrist in palmar flexion

PA OBLIQUE PROJECTION

Lateral Rotation

PP: Palmar surface against IR; hand pronated & rotated 45° laterally; wrist ulnar deviation (for scaphoid only)

RP: Midcarpal area

CR: ⊥

SS: Carpals on the lateral side (Scaphoid & Trapezium)

AP OBLIQUE PROJECTION

Medial Rotation

PP: Dorsal surface against IR; hand supinated & rotated 45° medially

RP: Midcarpal area

UPPER EXTREMITIES

CR: \perp

SS: Carpals on the medial side (Pisiform, Triquetrum & Hamate)

PA PROJECTION

In Ulnar Deviation

PP: Hand pronated; wrist in extreme ulnar deviation

RP: Scaphoid

CR: \perp ; 10-15° proximally/distally (clear delineation)

SS: Scaphoid; opens carpal interspaces on lateral side

ER: To correct scaphoid foreshortening

PA PROJECTION

In Radial Deviation

PP: Hand pronated; wrist in extreme radial deviation

RP: Midcarpal area

CR: \perp

SS: Opens carpal interspaces on medial side

STECHER METHOD

PA AXIAL PROJECTION

VARIATIONS:

- IR elevated 20°
- CR 20° toward elbow
- CR 20° toward digits
 - Fracture line that angles superoinferiorly
- Clench the fist

RP: Scaphoid

CR: \perp

SS: Scaphoid

ER (20° Angulation):

- To place scaphoid at right angles to the CR
- To project scaphoid w/o self-superimposition

Bridgman Method: Stecher Method with ulnar deviation

RAFERT-LONG METHOD

PA & PA AXIAL PROJECTIONS

In Ulnar Deviation

PP: Hand pronated; wrist in extreme ulnar deviation

RP: Scaphoid

CR: \perp ; 10°; 20°; 30° cephalad

SS: Scaphoid with minimal superimposition

ER: To diagnose scaphoid fractures

CLEMENTS-NAKAYAMA METHOD

PA AXIAL OBLIQUE PROJECTION

PP: Palmar surface against 45° sponge; hand in ulnar deviation; rotate elbow end of IR & arm 20° away from CR (unable to achieve ulnar deviation)

RP: Anatomical snuffbox

CR: 45° distally

SS: Trapezium

ER: To demonstrate trapezoid fractures

LENTINO METHOD

TANGENTIAL PROJECTION

PP: Hand palm upward; hand 90° to forearm

RP: 1.5 in proximal to wrist joint

CR: 45° caudad

SS: Carpal bridge

ER: To demonstrate fractures of scaphoid, lunate dislocation, dorsum of wrist calcifications and foreign bodies & dorsal aspect of carpal bones chip fractures

GAYNOR-HART METHOD

TANGENTIAL PROJECTION

PP: Wrist hyperextended; hand rotated slight toward the radial side (to prevent superimposition of hamate & pisiform shadows); digits grasp w/ opposite hand

RP: 1 in. distal to 3rd MCP base

CR: 20-30° to long axis of hand

SS: Carpal canal/tunnel (Carpal sulcus+Flexor retinaculum)

UPPER EXTREMITIES

ER:

- To demonstrate carpal tunnel syndrome
- To demonstrate fractures of hook of hamate, pisiform & trapezium

Mcquillen Martensen Suggestion

- For wrist that cannot be extended to w/in 15° of vertical
- CR aligned // to palmar surface
- Angled an additional 15° toward the palm

SUPEROINFERIOR PROJECTION

PP: Dorsiflex the wrist; lean forward (to place carpal canal tangent to IR)

RP: Midpoint of the wrist

CR: ⊥

SS: Carpal canal/tunnel

ER: Taken when patient cannot assume/maintain Gaynor-Hart Method

Marshall Suggestion

- For limited dorsiflexion of the wrist
- Placed 45° sponge under palmar surface of the hand
 - Slightly elevates the wrist to place the carpal canal tangent to CR
- With slight degree of magnification due to increased OID

F.) FOREARM

AP PROJECTION

PP: Hand supinated; patient lean laterally; humeral epicondyles // to IR

RP: Midshaft

CR: ⊥

SS: Elbow joints; radius & ulna; distorted carpal bones (proximal row)

- Slight superimposition of radial head, neck & tuberosity over the proximal ulna

Hand Pronation:

- It crosses the radius over the ulna at its proximal third
- It rotates the humerus medially

LATERAL PROJECTION

PP: Elbow flexed 90°; forearm & hand in true lateral; thumb must be up; humeral epicondyle ⊥ to IR

RP: Midshaft

CR: ⊥

SS: Elbow joints; radius & ulna; carpal bones (proximal row)

- Superimposed radius & ulna at their distal end
- Superimposed radial head over the coronoid process
- Superimposed humeral epicondyles
- Radial tuberosity facing anteriorly

G.) ELBOW

AP PROJECTION

PP: Elbow extended; hand supinated; patient lean laterally; humeral epicondyles & anterior surface of elbow // to IR

RP: Elbow joint

CR: ⊥

SS: Elbow joints; distal arm & proximal forearm

- Radial head, neck & tuberosity slightly superimposed over the proximal ulna

LATERAL PROJECTION

Lateromedial

PP: Elbow flexed 90°; elbow flexed 30-35° (suspected elbow injury); hand in lateral position; humeral epicondyles ⊥ to IR

RP: Elbow joint

CR: ⊥

SS: Elbow joints; distal arm & proximal forearm

- Superimposed humeral epicondyles

UPPER EXTREMITIES

- Radial tuberosity facing anteriorly
- Radial head partially superimposing coronoid process
- Olecranon process in profile

Griswold (Elbow flexing 90°): 2 reasons

- Olecranon process seen in profile
- Elbow fat pads are least compressed

AP OBLIQUE PROJECTION

Medial Rotation

PP: Hand pronated or medially rotated 45°; anterior surface of elbow 45° to IR

RP: Elbow joint

CR: ⊥

SS: Coronoid process in profile; trochlea

AP OBLIQUE PROJECTION

Lateral Rotation

PP: Hand laterally rotated 45°; 1st & 2nd digits touching the table; posterior surface of elbow 45° to IR

RP: Elbow joint

CR: ⊥

SS: Radial head & neck in profile; capitulum

AP PROJECTIONS

In Partial Flexion

Distal Humerus

PP: Hand supinated; elbow partially flexed

RP: Elbow joint

CR: ⊥ to humerus

SS: Distal humerus when elbow cannot be fully extended

Proximal Forearm

PP: Hand supinated; dorsal surface of forearm against IR; elbow partially flexed

RP: Elbow joint

CR: ⊥ to forearm

SS: Proximal forearm

ER (2 AP Projections): For patient cannot completely extend the elbow

JONES METHOD

AP PROJECTION

Acute Flexion

Distal Humerus

PP: Elbow fully (acutely) flexed

RP: 2 in. superior to olecranon process

CR: ⊥ to humerus

SS: Olecranon process

Proximal Forearm

PP: Elbow fully (acutely) flexed

RP: 2 in. distal to olecranon process

CR: ⊥ to flexed forearm

SS: Elbow joint more open

RADIAL HEAD SERIES

LATERAL PROJECTION

Four-Position Series

PP: Elbow flexed 90°; elbow joint in lateral position; four exposures: 1.) hand supinated 2.) hand in lateral 3.) hand pronated 4.) hand internally rotated

RP: Elbow joint

CR: ⊥

SS: Radial head in varying degrees of rotation

- Radial head facing anteriorly (1st & 2nd exposures)
- Radial head facing posterior (3rd & 4th exposures)

COYLE METHOD

AXIOLATERAL PROJECTION

PP:

- **Seated:** hand pronated
- **Supine (trauma):** distal humerus elevated; IR vertical; humeral epicondyles ⊥ to IR; palmar aspect of hand facing anteriorly
- Elbow flexed 90° (radial head) or 80° (coronoid process);

RP: Midelbow joint

UPPER EXTREMITIES

CR:

- **Seated:** 45° toward the shoulder (radial head); 45° away from the shoulder (coronoid process)
- **Supine:** horizontal; 45° cephalad (radial head); 45° caudad (coronoid process)

SS: Open elbow joint b/n radial head & capitulum or coronoid process & trochlea

ER:

- To demonstrate pathologic processes or trauma in the area of radial head & coronoid process
- Cannot fully extend elbow for medial & lateral oblique

PA AXIAL PROJECTION

PP: Seated; arm rested vertically against IR; forearm // to IR; humerus 75° from forearm or 15° from CR; hand supinated

RP: Ulnar sulcus

CR: ⊥

SS: Epicondyles; trochlea; ulnar sulcus (groove b/n medial epicondyle & trochlea); olecranon fossa

ER:

- Used in radiohumeral bursitis (tennis elbow)
- To detect otherwise obscured calcification located in the ulnar sulcus

Rafert-Long: AP oblique distal humerus for demonstration of ulnar sulcus

PA AXIAL PROJECTION

PP: Seated; arm 45-50° from vertical; hand supinated

RP: Olecranon process

CR: ⊥ or 20° toward the wrist

SS: Dorsum of olecranon process (⊥); curved extremity & articular margin of olecranon process (20°)

H.) HUMERUS

AP PROJECTION

Upright

PP: Erect/seated-upright (more comfortable); arm abducted slightly; hand supinated; humeral epicondyles // to IR

RP: Midshaft

CR: ⊥

SS: Humeral head & greater tubercle in profile

LATERAL PROJECTION

Lateromedial Upright

PP: Erect/seated-upright (more comfortable); arm rotated internally; elbow flexed approximately 90°; palmar aspect of hand against hip; humeral epicondyles ⊥ to IR

RP: Midshaft

CR: ⊥

SS: Lesser tubercle in profile; greater tubercle superimposed over humeral head

Mediolateral Upright

PP: RAO/LAO; patient's hand holding the broken arm

RP: Midshaft

CR: ⊥

SS: Lesser tubercle in profile; greater tubercle superimposed over humeral head

ER: For patients with broken humerus

AP PROJECTION

Recumbent

PP: Supine; unaffected shoulder elevated; hand supinated; humeral epicondyles // to IR

RP: Midshaft

CR: ⊥

SS: Humeral head & greater tubercle in profile

UPPER EXTREMITIES

LATERAL PROJECTION

Lateromedial Recumbent

PP:

- **Supine:** arm abducted slightly; forearm rotated medially; dorsal aspect of hand against patient's side; humeral epicondyles \perp to IR; elbow flexed slightly (for comfort)
- **Lateral Recumbent:** place IR closed to axilla; elbow flexed (unless contraindicated); thumb surface of hand up

RP: Midshaft or distal humerus (lateral recumbent)

CR: \perp

SS: Distal humerus

ER (lateral recumbent): For patient with known or suspected fracture

☺ THE END ☺

"BOARD EXAM is a matter of PREPARATION. If you FAIL to prepare, you PREPARE to fail"

03/18/14